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EASTERN DISTRICT

SEWAGE PURIFICATION WORKS,

DALMARNOCK,

ERECTED BY

THE CORPORATION OF THE CITY OF GLASGOW.
POLICE DEPARTMENT.

Opened on 2nd May, 1894.

THIRD EDITION.

GLASGOW:
PRINTED BY ROBERT ANDERSON, 22 ANN STREET.

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The Committee on Sewage Disposal directed that the following detailed Description of the Works should be printed for the information and guidance of the numerous visitors thereto.

By carefully following the guide from the point of the entrance chamber where the sewage first enters the Works, visitors will have no difficulty in gaining a very fair grasp and understanding of the system employed by the Corporation of Glasgow for the treatment of the portion of the Sewage of the City dealt with in the Works.

October, 1898.

DESCRIPTION OF WORKS.

Main Sewer.

Entrance Chamber.

Rotary Screens.

THE main sewer from the City, 7 ft. 6 in. in diameter, is brought down the centre of Swanston Street and led into the entrance chamber, which is 17 ft. × 9 ft. × 16 ft. 1 in. deep, and situated at the north-west corner of the precipitation tanks. On the east side of the chamber, in front of three 4-ft. penstocks, there is a wrought-iron grid, 3 in. wide, to catch heavy floating matter. From this chamber the sewage is taken into the machinery building by three 4 ft. × 4 ft. invert channels placed underneath the precipitation tanks and aerating beds to the west side of the catchpits, where it has to pass through three 4-ft. rotary screens made of cast steel, the bars of which are $\frac{5}{8}$ in. apart. It then flows into the 5-ft. feed channels on the west side of the catchpits. The level of this channel is 18 ft. 6 in. below floor line. Lifting plates, 4 ft. × 6 in., are securely attached every 4 feet to the rotary screens for the purpose of taking up all floating matter, and depositing it into a wrought-iron trough placed in front at a depth of 10 ft. 6 in. below the floor line. The rubbish here collected is passed into a square wrought-iron self-tipping bucket, which is daily emptied into the destructor furnace. The screens work at an angle of 45 degrees, and make 14 revolutions per minute.

Catchpits.

Elevators.

The sewage flows from the 5-ft. channel into the two catchpits, each of which is 47 ft. 10 in. long by 20 ft. broad and 10 ft. deep. The bottom of the catchpits at the elevator trough is 28 ft. 6 in. below the floor line, and rises to the north and south end walls, which enables the soft material to gradually come forward to the elevator trough, the bottom of which is 33 ft. 6 in. below the floor line.

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The solids are raised by the elevator buckets into a railway wagon on the floor level. Each catchpit can be wrought separately as may be required. The sewage, free of the heavy matter, thereon flows from the catchpits into a 10-ft. channel on the east side, leading to the pump well, the depth of which is 31 ft. 1 in. below floor line.

Pump Well.

Centrifugal Pumps.

The suction pipes from the centrifugal pumps are led down to within 15 in. of the bottom. The water is raised through these into a 3-ft. 9-in. cast-iron pipe placed against the south wall of the pump room, through which it flows into the mixing pit, where the chemicals are introduced. Sulphate of alumina and lime are the precipitants at present used, in the proportion of 2 of alumina to 1 of lime. The quantities used vary according to the nature of the sewage.

Mixing Pit.

Lime Mixers.

There are two 18-in. and two 15-in. pumps, with a total of 350 horse power, capable of raising $1\frac{1}{4}$ million gallons per hour. The two 6-in. pulley pumps on the east side of the pump-room discharge the sewage into the lime mixers over the sludge tank. This water is used for making milk of lime and dissolving the sulphate of alumina.

Engine-room.

Shafting.

Dynamo.

These pumps are driven from the main line of shafting, which is wrought from the engine-room, where there are two pairs of compound condensing engines, each of 120 horse power. The precipitated sewage water is used for the condensers. These engines drive all the shafting. There is a dynamo in this engine-room which gives off 130 amperes at 110 volts. There is also one compound wound dynamo, to give 250 amperes at 110 volts, situated in the pump room. Either of those can supply the whole light for the works. There are 35 arc lamps of 5 amperes each, and 160 incandescent lamps of 32 and 16 candle power.

Leaving the sewage water at the mixing pit, which is 10 ft. × 10 ft. × 8 ft., with a centre tongue going down to within 3 ft. 6 in. from the bottom, the sewage mixed with the chemicals passes under this tongue into an outlet channel, 8 ft. × 3 ft. 6 in., which leads to the feed channels of the precipitation tanks.

Mixing Pit.

The mixing pit is situated in the south-east corner of the main floor, over the catchpits.

The sludge from the precipitation tanks is brought into the Works by a 6-ft. 6-in. main channel, starting at a depth of 17 ft. 4 in. from the west wall of the sulphate of alumina room. This channel rises 3 in. in 100 feet till it reaches the front of the west section of the precipitation tanks. There is a sludge channel, 3 ft. 3 in. wide, in front of each section of the precipitation tanks, with a fall of 3 in. to the 100 ft. into the main channel, through which the sludge runs by gravitation into the sludge tank, which is under the sulphate of alumina room. This tank is 40 ft. × 46 ft. × 21 ft. below the floor line. The liquid sludge is raised from this tank by a 6-inch centrifugal pump into three sludge settling tanks and allowed to precipitate. When 50 per cent. of the water is run off into the pump well, the precipitated sludge is then drawn from these tanks into a tank 46 ft. × 40 ft. × 23 ft. below the floor line under the lime-mixing room. In the north-east corner there is a low-pressure sludge ram 29 ft. below the floor line, capable of holding 1,800 gallons, through which the sludge is raised by compressed air into the two sludge mixers at the east wall of the lime room. Here hot lime is added to the sludge to facilitate the pressing.

Sludge Channel.

Sludge Tank.

Low Pressure SludgeRam.

Sludge Mixers.

In the low floor of the sludge receiving room there are four high-pressed rams, each holding 900 gallons. The sludge runs from the mixers by gravitation through a 6-in. cast-iron pipe into these rams, from which it is raised by compressed air at 100 lbs. to the square inch into the sludge presses. When this air has blown the sludge from the high-pressed rams, it is then transferred into the large low-pressed ram in the north-east corner of the sludge tank, thereby effecting a saving of fully 80 per cent. of compressed air, by raising sufficient sludge into the mixers to again re-charge the high-pressed rams. To duplicate the high-pressed rams there is a horizontal duplex pump, with 11-in. cylinder, $7\frac{1}{2}$-in. pump, 10-in. stroke, capable of discharging 50 tons per hour of crude sludge against 100 pressure. This pump can draw direct from the sludge well or from the sludge mixers. The compressed air is made by two high-pressure engines to the north of the rams, where there is also a

High Pressed Rams.

Sludge Pump.

Compressed Air.

duplex steam pump for feeding the water into the boilers. To the south of the rams there is a bath-room for the employees.

Sludge Presses and Drying.

In the press room, on the top floor, there are 12 sludge presses, seven of which hold 25 cwts. each, and five 32 cwts. each, when fully charged, making a total of 16 tons 15 cwts. of pressed sludge cake each round of the presses. This sludge cake is dropped through shoots in the floor on to an endless band or conveyor, 115 ft. long, which conveys and discharges it on to a set of breakers where the cake is broken up as it falls into the railway wagons, which are immediately underneath. From this band or conveyor the pressed cake can be conveyed automatically into the drying machine, which reduces the moisture to 15 per cent.; it is then screened, disintegrated, and put up in bags, and sold as the "Globe Fertilizer Sewage Manure."

Boiler Shed.

Fuel.

In the boiler shed, to the north of the sludge receiving room, there are six 28-ft. × 7-ft. Lancashire boilers. The working pressure is 100 lbs. per square inch. The fuel used is the coke from the filtration beds when it has become too dirty for filtration purposes. There is no difficulty in keeping up steam with this fuel. At the north end of the shed there is a Babcock & Wilcox Economiser, through which the feed water is pumped into the boilers at 200° of heat. North of the engine-room there is a workshop for doing the necessary repairs.

Economiser

Workshop.

Feed Channels.

Returning to the sewage water as it enters the feed channels to the precipitation tanks at the north-east corner, it can be directed into either the eastern or the western double feed channels to the tanks. In each section there are 12 tanks, 50 ft. × 40 ft., capable of holding 81,000 gallons each, also 9 recently added tanks, 100 ft. × 50 ft., capable of holding 190,000 gallons each, making in all a precipitation tank capacity of nearly six million gallons. The 50 ft. × 40 ft. tanks are wrought on what is called the *Under-surface Continuous Flow System*, which is giving great satisfaction. The whole of the 42 tanks can be wrought on the intermittent system if required, when the clear water has been drawn off by the water drainers. The

Precipitation Tanks.

Under-surface continuous flow.

Water Drainers.

sludge is passed through a 12-in. disc valve into the 3-ft. 3-in. underground channel, and flows into the sludge tanks, as previously explained.

Disc Valves.

The water from the precipitation tanks passes into a 17-ft. 6-in. channel leading to the filtering beds, which are on the west side of Swanston Street. The water is syphoned through below the street in three cast-iron pipes, and rises into a 20-ft. main channel, from which there are four 5-ft. channels branching off to distribute the water into the filters. There are twenty downward coke filters, each 40 ft. × 10 ft. × 3 ft. 6 in., through which the water passes and rises in a 3-ft. open channel. It again passes down through the forty sand filters, each being 40 ft. × 38 ft. × 2 ft. 3 in. The sand in these filters, when it becomes dirty on the top, is washed with precipitated sewage water, which flows by gravitation to the sand-washing machine, and thereafter the sand is used over and over again. In addition to the above filters, there is a land filter, one acre in extent, on which the effluent can be passed if required. The water then passes into the 20-ft. effluent channel, thence through five flap valves into the outlet chamber, and finally into the River Clyde. The Works, as they at present stand, can deal with 15,000,000 gallons of sewage per day, or about one-fourth part of that of the entire city; but these works can be extended to treat twice that quantity. The area drained into these Works is 3,465 acres, with a present population of 265,000. The buildings, railway sidings, tanks, and filtering beds cover an area of 19 acres, out of 28 purchased and available. The land cost £35,500, and the buildings, tanks, and machinery an additional £96,600 = £132,100 in all.

Distributing Channels.

Coke Filters.

Sand Filters.

Land Filters.

Main Effluent Channel.

Capacity of Works.

THOS. MELVIN,
Manager.

REPORT BY THE GENERAL MANAGER ON THE OPERATIONS DURING THE YEAR 1897-98, AND COMPARISON WITH THOSE DURING THE PRECEDING YEAR.

	1896-97.			1897-98.		
Total Sewage dealt with,	3,530,219,000 gals.			3,741,455,000 gals.		
Average daily quantity,	9,670,463 ,,			10,223,164 ,,		
Average cost of Chemicals per million gallons,	£1	0	8$\frac{2}{10}$	£0	19	5$\frac{2}{10}$
Crude Sludge extracted by Precipitation,	172,116 tons.			183,968 tons.		
	Tons.	Cwts.		Tons.	Cwts.	
Sludge Cake from Filter Presses,	15,972	10		17,325	0	
Sludge raised by Elevators,	2,978	3		2,408	0	
Total Solids,	18,950	13		19,733	0	
Cost of Pressed Sludge Cake,	2s. 8$\frac{8}{10}$d. per ton.			2s. 4$\frac{9}{10}$d. per ton.		
Working Expenses per million gallons of Sewage treated—						
Pumping,	£0	9	11$\frac{9}{10}$	£0	10	4$\frac{8}{10}$
Precipitation, including Chemicals,	1	7	4$\frac{4}{10}$	1	5	4$\frac{9}{10}$
Filtration, including Coke,	0	6	10	0	6	11$\frac{2}{10}$
Sludge Pressing,	0	12	4$\frac{3}{10}$	0	11	2
	£2	16	6$\frac{6}{10}$	£2	13	10$\frac{9}{10}$

From the above statement it will be seen that during last year 3,741,455,000 gallons of Sewage were treated at the Works, which is equal to a weight of 16,720,322 tons 19 cwts. 2 qrs. 25 lbs., being an average of 10,223,164 gallons, or 45,731 tons 6 cwts. 19 lbs. per 24 hours.

From that Liquid Sewage there were extracted by Precipitation 183,968 tons of Crude Sludge, which was reduced by Filter Pressing to 17,325 tons, at an average cost of 2s. 4$\frac{9}{10}$d. per ton of Pressed Cake.

In addition to that quantity, 2,408 tons of Sludge were raised direct from the catchpit by the elevators. These two quantities make a total of 19,733 tons of solid matter removed from the Sewage during the year, which was disposed of thus—

	Tons.	Cwts.
Sold as Manure by the Cleansing Department,	1,613	15
Do. Sewage Department,	4,709	19
Manufactured into "Globe" Fertilizer,	3,200	0
Despatched by rail to refuse tips,	2,298	5
Deposited on ground at Works,	7,913	1
	19,733	0

As compared with the previous year, it will be observed that the figures indicating quantities all show increases, while those indicating cost, with the exception of a slight increase on the items for Pumping and Filtering, show reductions.

The quantity of Sewage treated is greater by 211,236,000 gallons.

The total Solids produced have been increased by 783 tons.

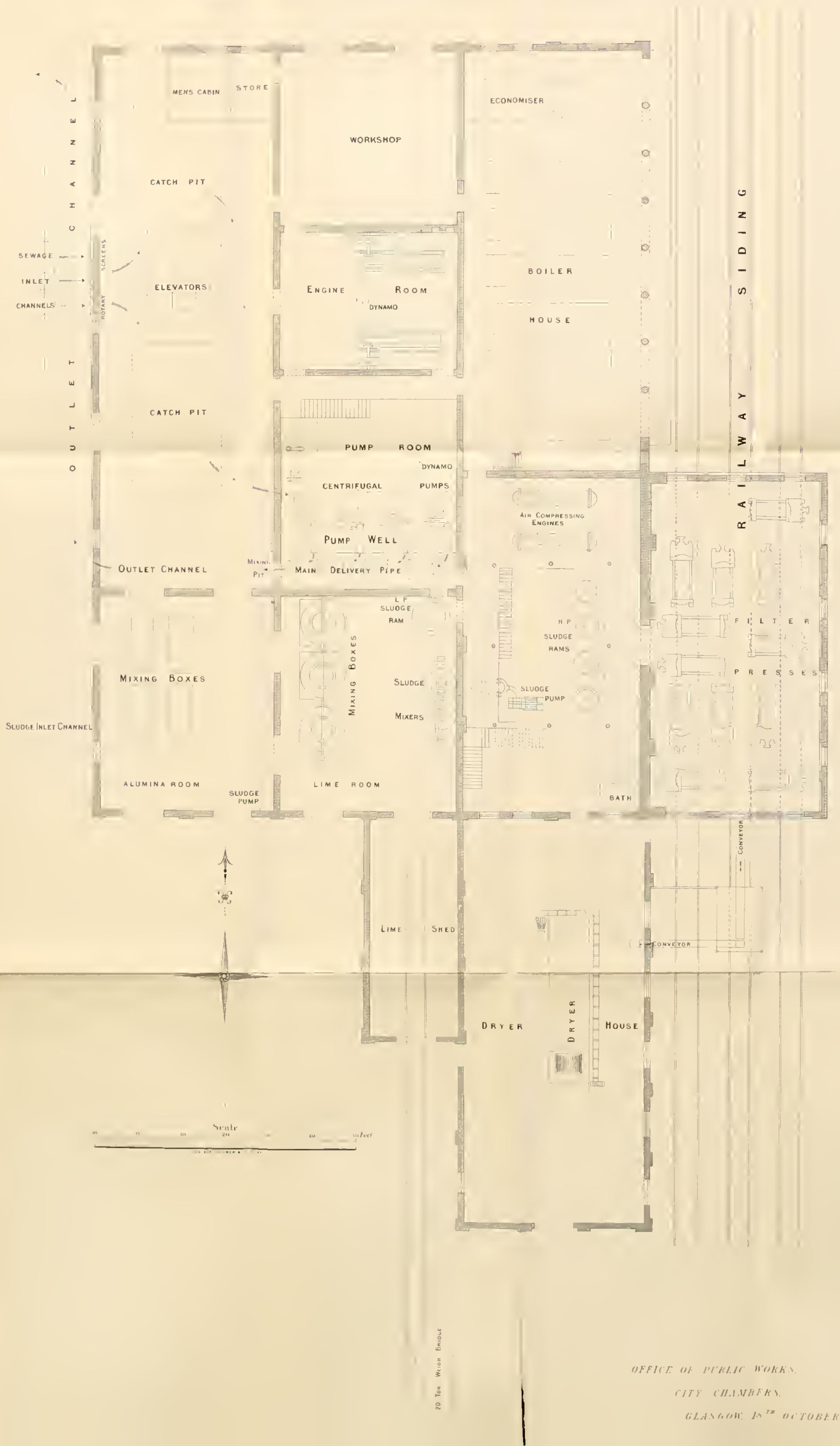
The average cost of Chemicals used, which last year had been reduced from the year preceding by 3d. per million gallons, was further reduced by 1s. 3d. per million gallons.

The Working Expenses, which in 1897-98 had been reduced from the preceding year by 4$\frac{8}{10}$d. per million gallons, have also been further reduced by 1s. 7$\frac{7}{10}$d. per million gallons this year.

MANURE ACCOUNT.

During the year 1,279 tons 18 cwts. 14 lbs. of "Globe" Fertilizer were sold at prices ranging from 20s. to 25s. per ton, free on rail, and 4,709 tons 19 cwts. of Pressed Cake were sold at 1s. 6d. per ton, free on rail. The total expenditure in connection with the Manure Account, as shown in the Treasurer's Statement, is £1,415 2s., less £208 for bags still in stock, leaving a balance of £1,207 2s. The revenue is £1,896 5s. 9d., thus showing a balance of £689 3s. 9d. in favour of the Manure Account, to which should be added £527 8s. 8d., being the savings effected at 8d. per ton on the 15,823 tons disposed of by the Sewage Department. These two amounts make a total of £1,216 12s. 5d., which would otherwise have been expended on the disposal of the sludge.

PLAN OF MACHINERY BUILDING



OFFICE OF PUBLIC WORKS,
CITY CHAMBERS,
GLASGOW, 18TH OCTOBER, 1898.

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